academicJournals

Vol. 10(22), pp. 2846-2853, 23 November, 2015
DOI: 10.5897/ERR2015.2172
Article Number: D6BB1F456358
ISSN 1990-3839

http://www.academicjournals.org/ERR

Educational Research and Reviews

Full Length Research Paper

The effects of computer games on the achievement of basic mathematical skills

Hamiyet Sayan

Uskudar University, Faculty of Health Sciences, Çarşı Yerleşkesi, İstanbul, Turkey.

Received 09 March, 2015; Accepted 22 October, 2015

This study aims to analyze the relationship between playing computer games and learning basic mathematics skills. It shows the role computer games play in the learning and achievement of basic mathematical skills by students. Nowadays it is clear that individuals, especially young persons are very fond of computer and computer games. Since students are very interested in computers, they can be used to achieve education and instructional objectives. This study aims to search for evidences whether computer games can be used to obtain basic mathematical skills. The study was conducted in 2012, with grade 5 elementary school students (44 in number). 22 of the students made up the experimental group, and the other 22 students constituted the control group. The two groups studied basic mathematical skills in two different ways after their teacher taught them as usual. A group studied the mathematical skills by playing math computer games; the other group did exercises as classical homework after being taught in the classroom. SPSS -''t test'' technique was used to examine the academic achievement of the two groups. All the students were given a Mathematics test of 25 questions related to basic skills operations. This test is used as the pretest and posttest. The result of the study showed that there is no significant difference between the group that learned basic mathematical skills with the aid of math computer games and the other group that learned basic mathematical skills alone without playing computer game.

Key words: Computer games and learning, mathematics and computer games, basic mathematical skills and computer games, effects of computers in learning, researches on computers and mathematics.

INTRODUCTION

Mathematics education

Mathematics is the science of patterns and layouts. In other words, it is the science of number, shape, space, size, and the relationships between them. Mathematics is also a universal language written with symbols and shapes. It involves information processing (editing, analyzing, interpreting and sharing), producing, predicting and solving problems (MEB 2009, p 7). Basic math skills consist of analyzing, problem solving with addition, subtraction, multiplication, division, fractions and decimals process skills (Hayes, 2005).

Mathematics education provides individuals with a wide perspective and knowledge to understand the

E-mail: hamiyet.sayan@uskudar.edu.tr. Tel: 905324055230.

world and enhance their social interaction and their skills. Mathematics helps people to analyze their various experiences, explain and solve problems systematically. It also facilitates creative thinking and provides aesthetic development. It accelerates the development of reasoning skills of individuals in various mathematical situations (MEB, 2009, p 7).

However, as important as the subject is, a lot of students still have phobia for it. Some have anxiety in learning it. This is due to the difficulty in comprehending it. This has made uncountable number of students to lack interest in its study; it is so sad to say that some students hate it. According to Garnett (1998), many students face math learning problems of different types; these learning difficulties range from mild to severe, and require instructional attention and various treatment methods. Some of the most common math learning problems include: (a) difficulty memorizing basic number facts; (b) computational and arithmetic weakness; (c) confusion about terminology and the written symbolic notation system of school math; and (d) weak understanding of concepts due to visual-spatial organization deficits. Apart from lower performance in math exercises and tests, these math learning disabilities can also result in avoidance behavior and negative perception of the particular subject. Often, students with math learning difficulties exhibit high math anxiety, which is defined as "a feeling of tension, apprehension, or fear that interferes with math performance" (Ashcraft, 2002).

As a result of this, teachers should utilize teaching methods that capitalize on the importance of mathematics, help students develop their math skills, and increase their self-efficacy beliefs (Meece et al., 1990). Moreover, it is very necessary to help students acquire a positive perception of mathematics, as this can lower math anxiety and higher math performance.

Although extensive studies have been done on educational computer games around the world, a wide gap still exists in studies focusing on the effectiveness of computer games in children's learning of certain subjects in schools. Hence, this research aims to investigate the effectiveness of computer-based game in facilitating children's learning of basic Mathematics. To achieve this aim, there are two objectives which the study seeks to fulfill:

1) To determine the relationship between the use of computer games and learning
2) To determine the effectiveness of computer games in children's acquisition of basic mathematical skills. In order to achieve the above objectives, this study attempts to answer the research following:

1.What is the difference in learning achievement of the students who used computer- game in learning basic mathematical skills and those who did not?

LITERATURE REVIEW

According to DeBell and Chapman (2006), of 58,273,000 students of nursery and K-12 school age in the USA, 56% of students played computer games. Along with the popularity among students, computer games have received a lot of attention from educators as a potential way to provide learners with effective and fun learning environments (Oblinger, 2006). Gee (2005) agreed that a game would turn out to be good for learning when the game is built to incorporate learning principles. Some researchers have also supported the potential of games for affective domains of learning and fostering a positive attitude towards learning (Ke, 2008). For example, based on the study conducted on 1,274 1st- and 2nd-graders, found a positive effect of educational games on the motivation of students.

Despite the overall support for the idea that games have a positive effect on affective aspects of learning, there have been different results regarding the role of games in promoting cognitive gains and academic achievement. In the meta- analysis, Vogel et al. (2006) examined 32 empirical studies and concluded that the inclusion of games for students' learning resulted in significantly higher cognitive gains compared with traditional teaching methods without games. Similarly, Annetta et al. (2009) tested the effects of educational computer games by incorporating them into a 5th-grade science class and found significantly positive results in the students' performance. Ke (2008) tested the effects of cooperative computer game-playing on the math achievement of 125 5th-graders compared with competitive game-playing and non-game-playing groups. The authors observed significantly higher improvement in math performance in both computer game-playing groups compared with the non-game-playing group.

However, other studies have not shown the same positive effects of games. By controlling important contextual variables such as socioeconomic status (SES), gender, and prior math achievement, Ke (2008) tested the effect of educational computer games compared with traditional paper-and-pencil drills. He did not find a significant effect of games on the math achievement of 487 5th-graders.

In another study, Ke (2008) recruited 4th- and 5th-graders to play educational math computer games during the summer math camp and measured their math ability at the onset of the program. At the post-test, the author found no significant effect of computer games on math achievement.

Past literature also indicated that game and play are some of the best approaches for learning (Harel and Papert, 1991; Kafai, 2001). However, contemporary society and educational discourse regards human learning only to be achieved through non-playful process as the public has associated gaining knowledge with

hard labour. In contrast to this dominant belief that learning is done through great effort and persistence, play and enjoyment can and should be considered as an integral part of a learning process.

In a recent study, Pareto et al. (2011) created a teachable-agent arithmetic game that aims in training basic arithmetics skills. The game was evaluated in a study with 153 participants, consisting of 3rd and 5th grade students. The results indicate that the game helped students improve their math performance and self-efficacy beliefs. Ahmad and Latih (2010) describe the development of an educational math game on fractions for primary school students. Similarly, Lee (2009) report on the creation and evaluation of an education game on fractions and mention that it improved students' understanding and performance.

According to Prensky (2001), learning requires extra effort. To do this, students must volunteer to to be involved in learning activities. Students learn something when they are motivated; they give their time as well as their effort. They have the desire to use what they have learned in future (Malone, 1980). Therefore, teachers should motivate and courage them to participate in learning activities if they want their students to learn. This could be achieved through the use of computer games, since they encompass many characteristics that make them valuable tools for the educational process. More specifically, computer games promote active learning (Oblinger, 2006) and the development of various skills (McFarlane, Sparrowhawk and Heald, 2002), while they retain their entertainment and appealing qualities (Kafai, 2001).

In this technology age, lifelong and widely used mathematical operations can easily and accurately be done with technologic products. In this situation instead of giving information to the students directly, they can be asked to do activities, and be guided to gain some skills through technology.

Games can be used in teaching of various disciplines. However, it said that most teachers do not take games seriously. Educators argue in favour of the social benefits of games more and ignore their educational potential (Squire, 2003).

Shute (2011) stresses on the use of instructional games to make learning more fun instead of banning them as a solution to education. These types of video games can be produced. Shute also specifies that, parents can play computer games with their children and spend time together so that they can learn the skills and experience while having fun.

However, the problem is that the purpose of the school does not coincide with the purpose of the games. Therefore, it cannot be achieved the incorporation of school programs into games. Recently, there has been the integration of education into games more than the integration of games into education.

Games and group work, presentations and activities like drama will make the students willing to participate in the course. These should be taken as a basis for teaching process.

Mathematics Program in Turkey lays emphasis on problem solving, communication, association, and the development of reasoning skills to prepare students for life (MEB, 2009).

If students succeed in problem solving, this can increase their confidence to solve new mathematical problems and therefore be able to demonstrate creative attitudes (MEB, 2009, p: 12). They will seek to restructure their knowledge when they learn to communicate using mathematics, and they will develop higher-order thinking skills. When they develop their reasoning skills and self-confidence, students will no longer see mathematics and formulas as rules to memorize; rather they will find mathematics enjoyable and meaningful.

Turkey renovated Elementary Mathematics Curriculum at the end of 2005, and brought student-centered and activity weighted approach to the school system.

This renewed program was based on experiences of developed countries, national and international research in mathematics education and mathematics programs in Turkey. This Mathematics Program leans on the principle "Every child can learn Math". The Math concepts are inherently abstract nature. Considering the children's development level, these concepts are very difficult to detect directly. Therefore, mathematics related concepts are discussed starting from concrete to finite life model.

The biggest problem in the expression and understanding of mathematics, as it is known, is the abstract nature of mathematical terms. This new Mathematics teaching program reduced the number of acquisition, and subjects were slightly more concretized. Thus, it is intended to facilitate understanding of the subjects by the students. Despite the innovation of Mathematics Education in Turkey, it has not reached the desired level of success. To support this view, SBS (Placement Test) conducted across the country and international level made TIMSS (Trends in International Mathematics and Science Study) and PISA (Programme for International Student Assessment) to be taken as references.

The following data were collected from the Ministry of Education in Educational Technology General Directorate of the site.

In Turkey, the ratio of 6, 7, and 8th grade students 'achievements in Mathematics test is in the range of 11.75-29.13% (MEB, 2009). Turkey is placed 31st position in Mathematics international tests like TIMMS, PISA and other related areas since 2000 till date (TIMMS, 1999; PISA, 2000; PISA, 2003, PISA, 2007; PISA, 2009 (MEB, 2003,s:4; MEB,s.V; OECD, 2007, s: 53; MEB, 2009, s: 15). According to 2012 PISA results, Turkey is under the 65 OECD countries in terms of

Mathematics (cnnturk.com, 2013).

In all tests, both national and international, it can be said that Turkey is not successful in Mathematical skills. It could be due to the methods, tools and materials used for the instruction and teaching. They should be changed.

Till date in Turkey, traditional methods are utilized for teaching Mathematics. These methods make the students passive and not involved in activity work. They may even eliminate the need to think. Therefore, learning mathematics becomes boring for the students. Mathematics classes ought to be full of fun, especially for students in lower classes. This will motivate them to learn and see the need to learn.

Today's children are extremely interested in and enjoy computer games. Computer games can be transferred into fun activities for children through the realization of the objectives of mathematics. While there is an alternative way to achieve the goal, insisting on the traditional ways will be laborous and time wasting. Cankaya and Karamete (2008) insist on using the appropriate computer games in teaching mathematics, considering the positive effects.

New technologies do not just bring convenience to the users; they also modify their habits, emotions and cognitive abilities (Severin and Tankard, 1992; Griffin, 2000; Erdogan and Alemdar, 2002).

Educational computer games are game format that allows students to learn the subject matter, or the software that develops problem-solving skills (Demirel et al., 2003). Yalın (2010) defines instructional media as physical environment where teaching and learning take place. The learning environment has to capture the students' interest, make them follow the activities and enable them to continue willingly in learning event. With this, the students can enjoy the process and also this will provide a more lasting learning.

Students learn best when they are motivated (Whitton, 2007). Mathematics learning involving the use of computer games brings motivation to both the students and educators.

Using computer games to teach Mathematics to arouse and engage children's' interest is a widely accepted social idea. A lot of research is done on the subject. Many schools and home computers have internet connection. Computer-assisted learning applications are increasing to capture the interest of the children. Students spend a lot of time and their energy on computer, so it tends to keep them away from their school learning. In this case, it becomes rational to include their school work in the computer games.

Jonker and Wijers (2008) say that, Math is not a subject students are interested in easily and naturally. In this case it is necessary to use a method that would make them active. They mentioned Th!nklets Program. They used it for their study in analyzing the effects of computer games on problem solving and also for motivation and withdrawals of interest. Many studies results are parallel with it.

Kula and Erdem (2005) examined the impact of the development of basic arithmetic skills with computer games. They reported that computer games did not have a statistically significant difference and did not affect the arithemetic skills of the students. They reported that results can be limited with "Add them up" Program (2005, pp: 127-135). Demirel et al. (2003) indicate that computer games have a great potential for both commercial and educational purposes. It is frequently repeated that computer games are beneficial for learning, but it is still a puzzle on how to integrate them into educational programs.

Roberson (2004) emphasizes if educational games can be integrated into classroom activities, they will have positive impact on learning. In recent years it is observed that children devote a long time for computer games; average of 4 h per week in 1980; the current use (especially boys) exceeds 10 h per week (Bayırtepe and Tüzün, 2007: 41). The educational games are software game that allows students learn lessons or improve their problem-solving skills (Bayırtepe and Salt, 2007).

DeBell and Chapman (2006; 37) revealed that, 59% of the children aged 5-17 and 63% of children aged 11-17 use computers at home to play games. Green and McNeese (2004) stated that if the factors and features of the games should be examined systematically, this theoretical approach will help in the realization of effective teaching.

Cognitive changes caused by the new digital technology and communication tools have led to changes in the needs and preferences of young people. Especially in education, preferences and needs of youths are changing.

Tapscott (1997) explains that today's young people are much different from their parents in learning, playing, communicating, working and constructing groups for work and creation. This is perhaps the biggest change taking place in education. Children want to play. In the technological environment their learning styles and habits are changing rapidly. As a main learning area, Mathematics is becoming increasingly boring if it does not involve technology. Even researches demonstrate that the games used for educational purposes should be hidden well inside. Also the entertainment features of the game should be integrated into teaching (İnal, 2005, p145).

Kurfalli (2005) studied "The Effect of Computer Games on Education Activity". In the study he asked: how often, how long, where and what kind of computer games do the adolescents play, and also if this work blocks their social activities, in what conditions do they play the games and do they benefit from these games in their learning activities or not?. Kurfalli found the positive effects of computer games on students' learning.

Computer game contributes to adolescents' achievement levels in education, develops their creativity, because it allows the exchange of information (Yeşilyurt, 2014, p: 9).

Till date, there are not enough evidence on teaching goals that blend education and game. As a result, there is need to have much extensive research on this subject.

Tüzün (2006) states that computer games meet children's needs of development, improvement and success. For children at the developmental age, digital games develop their hand-eye coordination, and it was found that they also enhance problem solving and multi-mandated skills. In addition, computer games can be used to evaluate the success of students without them being aware. There are advantages of confidential assessment compared to conventional methods. Computer games may be used for this purpose. While students are playing games, they can produce different responses to problems and teachers can understand where the students are not doing well and where they are doing well. Computer games can help to assess students' progress, too. This is not only in determining the students' situation in a specific area, but it also reveals that there are certain areas that need to improve where feedback also should be used. Computer games also provide an opportunity to learn quantitative evaluation. Individual arrangements can be made for this evaluation (Shute, 2011).

The research reveals that computer games have both negative and positive effects. These effects are emerging as psychological and physiological problems (Gürcan et al., 2008, p: 7-8).

METHOD OF THE STUDY

Research material

This study was carried out with pretest-posttest models used for the control and experimental groups. The study used computer game, scholastics program originally designed to teach basic mathematics to the experimental group students.

The scholastics program was prepared for the students and teachers of elementary schools according to the New Turkish Elementary Curriculum. It can be reached on the internet. With it, students can have audio and visual activities, educational games and test online. They can also read e-books, solve problems, have practical tests, and play games there. It is online and users have to pay for it. This content was commissioned by a particular publishing firm. Progress of students who are members of the program can be controlled by teachers. With the programme, primary students of 2-8 grades are taught Turkish, Mathematics, Social Studies, Science and Technology, and Social Studies of the curriculum and English Lectures and courses as well as the appropriate individual exercises they can use in the classroom. Teachers can give students homework through the program and the results can be checked online. Each grade level to increae motivation, and various educational games for each subject are offered to students. Students may do the tests eight times a year. Exams can be considered individually and collectively. One lesson or lessons can be observed collectively.

In this study, this program is used because students and teachers use it in their daily life, and it is developing increasingly.

The study aims to generate a variety of data sets, allowing a comparison between students who participated in the game and students who did not. Data sets include gender, race, and locality (urban students versus rural students).The various data groups were tested using identical testing situations and materials to allow a quantitative comparison of the scores of students participating in the game and t h o s e not participating in the game.

Experimental design

This research was performed in an elementary school in İstanbul, Turkey. There are 44 students who participated in this work; they are 5th grade students in the same class. The research was done from March 25th- April, 2012. 5th Grade Curriculum of Primary Mathematics 1-5 was used, with the title, "Four Operations of Natural Numbers". The experimental group has 22 students and the control group has 22 students. Both groups were given a 25-question pretest. This test is also used as posttest.

The students studied the subject by using classical method in the classroom. All the students had the 25 questions test as pretest after their teacher has taught them in the usual way. The students were separated into experiment and control groups. They were grouped according to their pretest points. At first, the students were asked of the group they wished to join. After they were grouped, they were given homework and exercises on the subject. The assignment of the experimental group was to use Scholastics Program'' game to solve maths problem, '' Operations of Natural Number'. Then the next day, all the groups were given the same test as posttest which was given as pretest at the beginning of the application. Their points were defined and the pretest and posttest results of the two groups were compared. The data were analyzed with SPSS -''t test'' technique.

RESULTS

The results of the research are presented in tables. In Table 1, in the pretest and posttest results of the experiment and control groups, the means are distributed from 69.0 to 75.6 points since the standard deviations vary in a range from 19.4 to 16.7. The difference between the mean of pretests and posttests of the groups can be seen in Table 2.

As seen in Table 2, there is a difference between the average points of the experiment group and control group. The difference is 0.27 point in favor of the control group before the implementation of the pretest. However, this is not statistically meaningful (p=0.68). Thus, it is submitted that the two groups are equivalent and it is suggested to start the implementation of the pretest.

The average points of the experiment group's posttest are higher (0.55) than the average points of the experiment group's pretest. It is meaningful and statistically different (p=0.002). It means the experiment group is successful after the test.

The average point of the posttest of control group is After the implementation of the homework, both groups have learned and got high points from the posttest and became successful. Statistically differences are

Table 1. The results of pretests and posttests of the experiment group and control group.

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Exper.group pretest-	69,0909	22	16,47772	3,51306
	posttest	75,6364	22	16,69487	3,55936
Pair 2	Control group pretest-	69,3636	22	14,49317	3,08995
	posttest	73,8182	22	14,79909	3,15518
Pair 3	Exper. group pretest	69,0909	22	16,47772	3,51306
	Control group pretest	69,3636	22	14,49317	3,08995
Pair 4	Exper. group posttest	75,6364	22	16,69487	3,55936
	Control group posttest	73,8182	22	14,79909	3,15518

Table 2. Mean differences and 95% confidence intervals of Pre and Posttests of the two groups.

Comparison Groups	Paired Groups t Test Results				
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference	
				Lower	Upper
Pre and Post test of Exp. Group	-6,54545	8,51177	1,81472	-10,31936	-2,77155
Pre and Post test of Cont. Group	-4,45455	8,59528	1,83252	-8,26548	-,64361
Postt. of Exp. and Cont.Group	-,27273	3,04227	,64861	-1,62159	1,07614
Pre-Post Tests of Exp. and Cont.Group	1,81818	11,02221	2,34994	-3,06879	6,70516

Table 3. Results of paired groups t test.

Comparison groups		t	df	P value
Pair 1	Exper. group pretest – posttest	-3,607	21	,002
Pair 2	Control group pretest-posttest	-2,431	21	,024
Pair 3	Experiment group pretest –Control group pretest	-,420	21	,678
Pair 4	Exper. group posttest – Control group posttest	,774	21	,448

meaningful. That means both kinds of exercises resulted in good learning.

The last comparison is between the posttests of the average of the two groups. There is a difference in favor of the experiment group. The difference is 1.82 points, and it is not statistically meaningful (p=0.448) (Tables 3 and 4).

DISCUSSION AND CONCLUSION

Till date researchers have not been able to clearly state the effects of computer games on the instructional objectives of schools. Thus, more research works are needed. It is difficult to study due to the nature of the instructional objectives and their connection with games. It needs also more detailed analysis. In this study, the problem is 'what is the impact of doing exercises and assignment using computer games compared to the classical exercises in teaching basic Mathematical skills?' Like other results, this study has found no significant difference between both methods. Ke (2008) recruited 4th- and 5th-graders to play educational math computer games during the summer math camp and measured their math ability at the onset of the program. At the post-test, he found no significant effect of computer games on math achievement. Anderson and Bushman (2001) and Provenzo (1991) viewed video games as promoting violence, social isolation, aggression, or negative imagery of women. Video games in this light have been regarded as pure entertainment.

On the other hand, Wilson et al. (2006) created an adaptive computer game for dyscalculia and tested it in

Table 4. Correlation of groups of pretest-posttest.

		N	Correlation	Sig.
Pair 1	Experiment group pretest and posttest	22	,868	,000
Pair 2	Control group pretest & posttest	22	,828	,000
Pair 3	Experiment group pretest & Control group pretest	22	,989	,000
Pair 4	Experiment group posttest & Control group posttest	22	,761	,000

a five-week evaluation study with nine children with math learning difficulties. The results indicated an increase in the children's math performance on core number sense tasks, as well as an improvement in their confidence in their mathematical abilities. Annetta et al. (2009) tested the effects of educational computer games by incorporating them into a 5th-grade science class and found significantly positive results in the students' performance. Zavaleta et al. (2005) suggest in their study that the use of a commercial game for elementary school algebra enhanced students' achievement. Kebritchi et al. (2010) investigated the impact of commercial math games on 193 high school students' math performance, and found positive results in the student's perception of mathematics, motivation, and achievement.

Using computer games to learn basic arithmetical skills is as less effective as using the classical ways. Consequently, it can be said that the subject needs more studies and of course from a different perspective.

We could not obtain any evidence if one group is better than the other for two reasons: First, the sample size is rather small (n=22); the experiment should be repeated using bigger sample size. Second, before the experiment, results indicated that control group point is slightly higher than the experiment group point. However pretest results indicated that experiment group may get meaningful difference if big sample size could be measured more sensitively.

It must not be overlooked that if the number of the students is increased the results can tend to be positive for the experimental group. To know the positive effect of computer games, we need to have more studies using different and wide groups. New researches can be controlled with cross-over trial so that it can take the result closer to a positive one.

Development and information technologies draw children closer to computer games. As a result, computer games can be used for achieving educational goals (Altan and Tüzün, 2010). But it is still emphasized that computer games are beneficial for learning and can be used for school instructions (Barab et al., 2008).

While using instructional tools like computer games in education, educators must get help from learning theories and researches. These are cognitive theories, multiple intelligences, constructivist theories, cognitive loan theories, cognitive flexible theories, and multiple media theories. It is important for the games to obey the rules of the theories in order to achieve Instructional goals. For example: Multiple Intelligences Theory states that individuals have eight kinds of intelligence; these intelligences should be used during teaching and learning (Green and McNeese, 2004).

Abbreviations

MEB: National Ministry of Education in Turkey.

Conflict of Interests

The author has not declared any conflicts of interest.

REFERENCES

Ahmad WFBW, Latih NHBA (2010). 'Development of a Mathematics courseware: Fractions', Proceedings of the Fifteenth Asian Technology Conference in Mathematics, Kuala Lumpur, Malaysia, 17-21 December 2010.

Altan T, Tüzün H (2010). Teknoloji-Zengin Bireysel Öğrenme Ortamlarında Öğrenme Pratiğinin İncelenmesi. Konya: 4. Uluslararası Bilgisayar ve Öğretim Teknolojileri Eğitimi Sempozyumu/24-26 Eylül 2010.

Annetta L, Mangrum J, Holmes S, Collazo K, Cheng MT (2009). Bridging reality to virtual reality: Investigating gender effect and student engagement on learning through video game play in an elementary school classroom. Int. J. Sci. Educ. 31(8):1091-1113.

Ashcraft MH (2002). Math Anxiety: Personal, Educational, and Cognitive Consequences. Psychol. Sci. 11(5):181-185.

Barab S, Warren S, Goble AI (2008). Conceptual Play Spaces. Handbook of Research on Effective Electronic Gaming in Education, pp. 1-20.

Bayırtepe E, Tüzün H (2007). Oyun Tabanlı Öğrenme Ortamlarının Öğrencilerin Bilgisayar Dersindeki Başarıları Ve Öz-Yeterlik Algıları Üzerine Etkileri. Hacettepe Üniversitesi Eğitim Fakültesi Dergisi 33:41-54.

Cankaya S, Karamete A (2008). Eğitsel Bilgisayar Oyunlarının Öğrencilerin Matematik Dersine ve Eğitsel Bilgisayar Oyunlarına Yönelik Etkisi. Mersin Üniversitesi Eğitim Fakültesi Dergisi 4(2):115-127.

DeBell M, Chapman C (2006). Computer and internet use by students in 2003. Washington, DC: National Center for Education Statistics.

Demirel Ö, Seferoğlu S, Yağcı E (2003). Öğretim teknolojileri ve materyal geliştirme, Ankara: Pegem A Yayıncılık.

Erdogan İ, Alemdar K (2002). Öteki kuram: kitle iletişimimde yaklaşımların tarihsel ve eleşetirsel bir değerlendirmesi Ankara:Pozitif Matbaacılık.

Garnett K(1998). Math Learning Disabilities Division for Learning Disabilties. Journal of CEC.

Gee JP (2005). Why are video games good for learning? www.academiccolab.org/resources/documents/MacArthur.pdf.

Green ME, McNeese MN (2004). Using Computer Games In Online Education: What Are Students Really Learning? World Conference

on E-Learning in Corporate, Government, Healthcare, and Higher Education (ELEARN) 1219.
Griffin EA (2000). First look at communication theory. Boston: McGraw-Hill.
Gürcan A, Serdar Özhan S, Uslu R (2008). Dijital Oyunlar ve çocuklar üzerine etkisi Ankara: ASAGEM. s.7-8.
Harel I, Papert S (Eds) (1991). Constructionism. Ablex Publishing Corporation. Norwood, NJ.
Hayes N (2005). Reclaiming Real "Basic Skills" in Mathematics Education. New Horizons for Learning. http://www.newhorizons.org 12.05.11.
İnal Y, Çağıltay K, Sancar H (2005). Factors on Effecting Game Prefences of Children. TBD Bilişim Kurultayı, Ankara pp. 145-149.
Jonker J, Vincent J, Wijers M (2008). Thinklets for Mathematics Education. Re-using Computer Games Characteristics in Educational Software. The 8th international conference on International conference for the learning sciences – Vol. 1), International Society of the Learning Sciences.
Kafai YB (2001). "The educational potential of electronic games: From games-to-teach to games-to-learn." Playing by the Rules, Cultural Policy Center, University of Chicago.
Ke F (2008).Computer Games Application Within Alternative Classroom Goal Structures: Cognitive, Metacognitive, and Affective Evaluation. Educ. Technol. Res. Devel. (56): 539-556.
Kebritchi M, Hirumi A, Bai H (2010) 'The effects of modern mathematics computer games on mathematics achievement and class motivation', Comput. Educ. 55(2):427-443.
Kula A, Erdem M (2005). Öğretimsel Bilgisayar Oyunlarının temel Aritmetik İşlem Becerilerinin Gelişimine Etkisi (29):127-136.
Kurfalli H (2005) "The Effect of Computer Games Education Activities". Gaziantep University Science Congress.
Malone TW (1980). What makes things fun to learn? As study of intrinsically motivating computer games. California: Palo Alto Research Center.
McFarlane AE, Sparrowhawk A, Heald Y (2002). Report on the educational use of games. TEEM/DfES MEB(2009). PISA 2003 Projesi Ulusal Nihai Rapor.
MEB (2009). İlköğretim Matematik Dersi 1-5. Sınıflar Öğretim Programı.
MEB (2009). PISA 2003 Projesi Ulusal Nihai Rapor.
MEB. (2009). PISA 2009 Uluslararası Öğrenci Değerlendirme Programı Ulusal Ön Raporu Method and System For Desining Adaptive Diagnostic Assesments (2005). Wwww.todbox.com.
Meece JL, Wigfield A, Eccles JS (1990). Predictors of math anxiety and its consequences for young adolescents' course enrollment intentions and performance in mathematics.J. Educ. Psychol. 82:60-70.
Oblinger DG (2006). Games and learning. EDUCASE Quarterly, 29(3):5-7.
Organization for Economic Co-operation and Development. (2007). PISA 2006: Science competencies fortomorrow's world. Paris, France: OECD Publications. http://www.oecd.org/dataoecd/15/13/39725224.pdf 12/05/2011
Pareto L, Arvemo T, Dahl Y, Haake M, Gulz M (2011). A teachable-agent arithmetic game's effects on mathematics understanding, attitude and self-efficacy.AIED'11 Proceedings of the 15th international conference on Artificial intelligence in education, pp. 247-255.
PISA Sonuçları.http://www.cnnturk.com/2013/turkiye/12/04/pisa-sonuclari-aciklandi-turkiyenin-egitim-sisteminin-durumu/733167.0/index.html
Prensky M (2001). Digital Game-Based Learning. New York: McGraw-Hill.
Provenzo EF (1991): Video Kids: Making Sense of Nintendo. Cambridge, MA: Harvard University Press.
Roberson MS (2004). Video games as an educational tools. Retreived June 13, 2004 from http://www.cs.cmu.edu/~smrobert/tucson/~WRL1346.tmp. Page 12
Severin WJ, Tankard JW (1992).Communication theories: Origins, methods, and uses in the mass media. London: Logman group Ltd.
Shute VJ (2011). Game On/Instructioonal Design Reserch Works To Make Learning Fun. Higher Education Study. Open source learn. http://www.eurekalert.org/pub_releases/2011-02/fsu-goi021411.php
Squire K (2003). Video Games in Education http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.100.8500
Tapscott D (1997). Growing up Digital: The rise of the net generation. McGraw-Hill.
Tüzün H (2006). Eğitsel bilgisayar oyunları ve bir örnek:Quest Atlantis Hacettepe Üniversitesi Eğitim Fakültesi Dergisi (30):220-229.
Whitton N (2007). Motivation and Computer game based learning. Proceedings ascillite Singapore pp. 1063-1067.
Wilson AJS, Dehaene P, Pine SK, Revkin L, Cohen DC (2006).Behav Brain Funct. 2:19.
Yalın Hİ (2010). Öğretim teknolojileri ve materyal geliştirme.Ankara: Nobel Yayın Dağıtım.
Yeşilyurt F (2014).Yayınlanmamış Doktora Tezi.İstanbul.
Zavaleta J, Costa M, Gouvea MT, Lima C (2005). 'Computer games as a teaching strategy', Proceedings of the Fifth IEEE International Conference on Advanced Learning Technologies (ICALTy', pp. 257-259.